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RESEARCH ARTICLE

Pests and pathogens threatening urban vegetation in 'St. George' City Park in Dobrich, northeastern Bulgaria

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Abstract

Urban environments host invasive species that threaten tree and shrub vegetation in green infrastructure. In recent years, non-native pests and pathogens have been identified in Bulgaria, causing significant damage to host plants and altering the species composition of urban green spaces. The current study aimed to evaluate the risk of invasion and spread of aggressive insect pests and fungal pathogens, leading to the degradation of tree and shrub vegetation in urban green areas of a pilot site—the largest city park, 'St. George', in Dobrich (northeastern Bulgaria). From 2024 to 2025, the health status of 46 tree and shrub species was assessed using specific indicators, including crown defoliation, the presence of dried or rotted trees that could pose a threat to human health, and the presence of pests and pathogens that could cause allergic reactions. A mobile-based system with ArcGIS Field Maps was used to collect data during the field assessment. This system included 20 indicators for evaluating tree health status and transferring the data to electronic records. The most important pests that caused severe damage were oak (*Corythucha arcuata*) and sycamore (*C. ciliata*) lace bugs, *Cinara cedri cedri*, found on *Cedrus atlantica*; both the leaf miner (*Cameraria ohridella*) and the horse leaf blotch fungus *Phyllosticta paviae* caused leaf damage and premature defoliation of horse chestnut (*Aesculus hippocastanum*) leaves. Pine species were affected by the pathogens *Dothistroma septosporum*, *D. pini* and *Diplodia sapinea*. The fungal pathogen *Botryosphaeria dothidea* caused severe blight and dieback on *Sequoiadendron giganteum* trees. A xylariaceous ascomycete, *Biscogniauxia mediterranea*, a causal agent of charcoal canker disease, was detected on *Quercus cerris* and *Q. rubra* trees. The adverse effects of invasive pests and pathogens have worsened the health of tree species and reduced the ecosystem services provided by Dobrich's largest city park.

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Water stress during recent growing seasons appears to have reduced trees' resistance and increased their vulnerability to infection by invasive pests and pathogens.

Keywords
health status, threats, urban vegetation, invasive pests and pathogens, Dobrich, Bulgaria

Introduction

In the era of globalisation, more people in large cities are seeking the multifunctional benefits of urban green spaces (Mexia et al., 2018). Green infrastructure, such as urban parks, gardens, and street landscaping, helps mitigate the adverse effects of climate change and promotes sustainable urban growth. The European strategy for developing green infrastructure in large cities aims to support the sustainable development of green spaces in urban areas, adapt tree vegetation to climate change, and prevent the invasion of alien pests and pathogens (Štrbac et al., 2023). Regulating ecosystem services significantly contributes to human well-being in cities. They can help mitigate urban heat island effects, lessen climate change impacts, and reduce air pollution (Haase et al., 2014). These ecosystems also provide aesthetic and cultural values to the city and lend structure to the landscape (Bolund, Hunhammar, 1999).

Over the past decades, the main structural parts of urban green spaces, forests natural stands and plantations have increasingly faced threats from alien insect pests and fungal pathogens throughout Europe (Panzavolta et al., 2021; Raum et al., 2023; Augustinus et al., 2024). Introduced pests and pathogens pose an increasing threat to native plant species, disrupting the natural biodiversity and ecological balance in both forests and urban areas (Tubby, Webber, 2010; Panzavolta et al., 2021). In Bulgaria, the most significant examples demonstrate the economic and environmental impacts that have facilitated the spread of aggressive invasive species in urban green infrastructure (Georgiev et al., 2017). Dutch elm disease, caused by *Ophiostoma ulmi* (Buisman) Melin & Nannf., continues to kill elm trees (*Ulmus* spp.) throughout the country. Damage from the leaf-mining moth *Cameraria ohridella* (Deschka & Dimić) and horse leaf blotch (*Phyllosticta paviae*, Desmazières) causes horse chestnut (*Aesculus hippocastanum* L.) leaves to fall prematurely in mid-summer. Boxwood plants are heavily infested with the invasive moth *Cydalima perspectalis* (Walker).

New fungal pathogens have recently been reported in Bulgaria, causing damage to native tree species in forest nurseries and plantations. The pathogen *Sirococcus conigenus* (Pers.) Cannon et Minter was identified as the cause of a highly damaging infectious disease affecting native tree species, such as *Picea abies* (L.) Kars. (Dobreva et al., 2017) and *Pinus peuce* (Griseb.) (Georgieva et al., 2021). New areas in urban green spaces have also been affected by *Botryosphaeria dothidea* (Moug. ex Fr) Ces. & De Not, which causes necrotic disease and the gradual death of entire trees of *Sequoiadendron giganteum* (Lindley) Buchh. and *Sequoia sempervirens* (Don) Endl. (Georgieva, 2013). Since 2020, *Lecanosticta acicola* (Thümen) Sydow, a foliar patho-

gen mainly affecting *Pinus sylvestris* L., has been spreading its range and increasing its impact in the southeastern part of the country (Georgieva et al., 2020). In northeastern Bulgaria, *Dothistroma septosporum* (Dorogin) Morelet, *D. pini* Hulbary and *Diplodia sapinea* (Fr.) Fuckel are considered the most destructive pathogens of *Pinus nigra* Arn. plantations.

Higher summer temperatures and irregular rainfall have contributed to declines in tree health, along with the spread of invasive insect pests and pathogens in urban green spaces. It is essential to identify these threats early and prevent them from spreading widespread. Of particular concern is the rapid development of the fungal pathogen *Bisogniauxia mediterranea* (De Not.). Kuntze on oak species (Georgieva et al., 2024), and *Cryptostroma corticale* (Ellis & Everh.) Greg. & S. Waller on maples, particularly sycamore (*Acer pseudoplatanus* L.) and Norway maple (*A. platanoides* L.) (Bencheva, 2014; Georgieva et al., 2025).

Introduction and spread of alien invasive species in urban green areas require solutions, such as effective phytosanitary measures for diagnosing and monitoring tree health, as well as pest and pathogen risk modelling and analysis, to support sustainable management. The correct identification of fungal pathogens and pests is of great practical importance to municipal managers. Maintaining park vegetation in good health can be achieved by implementing an environmentally effective program to prevent, suppress, and regulate insect and pest levels in urban green areas. Understanding the phases of pest invasion – arrival, establishment, and spread is crucial for management and the proper application of control tools (Waring, O'Hara, 2005). Each phase requires knowledge of, or predictions about, the growth and spread of pest and pathogen populations for effective management.

This survey was conducted within the *COST Action CA20132 – Urban Tree Guard – Safeguarding European urban trees and forests through improved biosecurity (UB-3Guard)*. The study aimed to assess the threat posed by the spread of aggressive insect pests and fungal pathogens, which cause deterioration of tree and shrub vegetation in the pilot site – 'St. George' City Park in Dobrich (northeastern Bulgaria). The park was established in 1867, making it the second-oldest garden in Bulgaria. Previously, it spanned 1.5 hectares. Witnesses of this early era are the six ash trees (*Fraxinus angustifolia* Vahl) at the park entrance, which remain alive and protected today. In the city's planning archives dating back to 1890, the urban layout and the planned design of the city garden are clearly visible. Currently, a mixed landscape and geometric park design is used in 'St. George' City Park, which now covers an area of 2.5 hectares.

Materials and methods

Study area

Field observations were conducted from 2024 to 2025 at 10 selected sample plots (SP), covering an area of 0.83 hectares within the 'St. George' City Park in Dobrich (Table 1, Fig. 1).

Fig. 1. Map of studied sample plots in 'St. George' City Park, Dobrich.

Table 1. Geographical characteristics of the studied sample plots.

Sample plot	Latitude, N	Longitude, E	Altitude, m	Area, ha	Number of tree/ shrub species	Number of trees
SP1	43.561167	27.830556	210	0.12	4	41
SP2	43.560542	27.830619	210	0.08	5	39
SP3	43.559722	27.829728	210	0.06	4	38
SP4	43.559378	27.829603	221	0.10	4	36
SP5	43.559325	27.826528	221	0.09	5	38
SP6	43.559617	27.824242	218	0.06	5	37
SP7	43.560422	27.824653	210	0.11	3	38
SP8	43.560361	27.825997	211	0.06	6	39
SP9	43.559761	27.828733	218	0.08	4	40
SP10	43.559989	27.828381	222	0.07	4	44
			Total	0.83	45	390

Evaluation of crown indicators

The harmfulness and impact of pests and fungal pathogens that damage trees and shrub vegetation were evaluated based on crown condition assessment, following the methodology of the *International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forest (ICP 'Forests')* (Eichhorn et al., 2023). Crown defoliation was visually estimated as a primary indicator of crown condition and vital-

ity (Ferrety, 1997). The estimated values ranged from healthy trees (0-10% defoliated), slightly defoliated (>10-25%), moderately defoliated (>25-60%), severely defoliated (>60-90%), and 100% (dead tree). Description of the symptom (devoured, broken, tanned) and determination of the causes (fungal pathogens, insect pests, abiotic agent, anthropogenic damage) were applied.

Data collection of tree health assessment

A mobile-based system using *ArcGIS Field Maps Urban Green Area* from *ESRI* served as a platform for collecting field data (Fig. 2) (Georgieva et al., 2025). A layer called 'Health Assessment' was created, and the database structure was implemented with its attribute fields. It features 20 dedicated fields for assessing urban tree health and photos, and transferring them to electronic records (Table 2). A database was created in Microsoft Excel to organise the information, which facilitated its analysis.

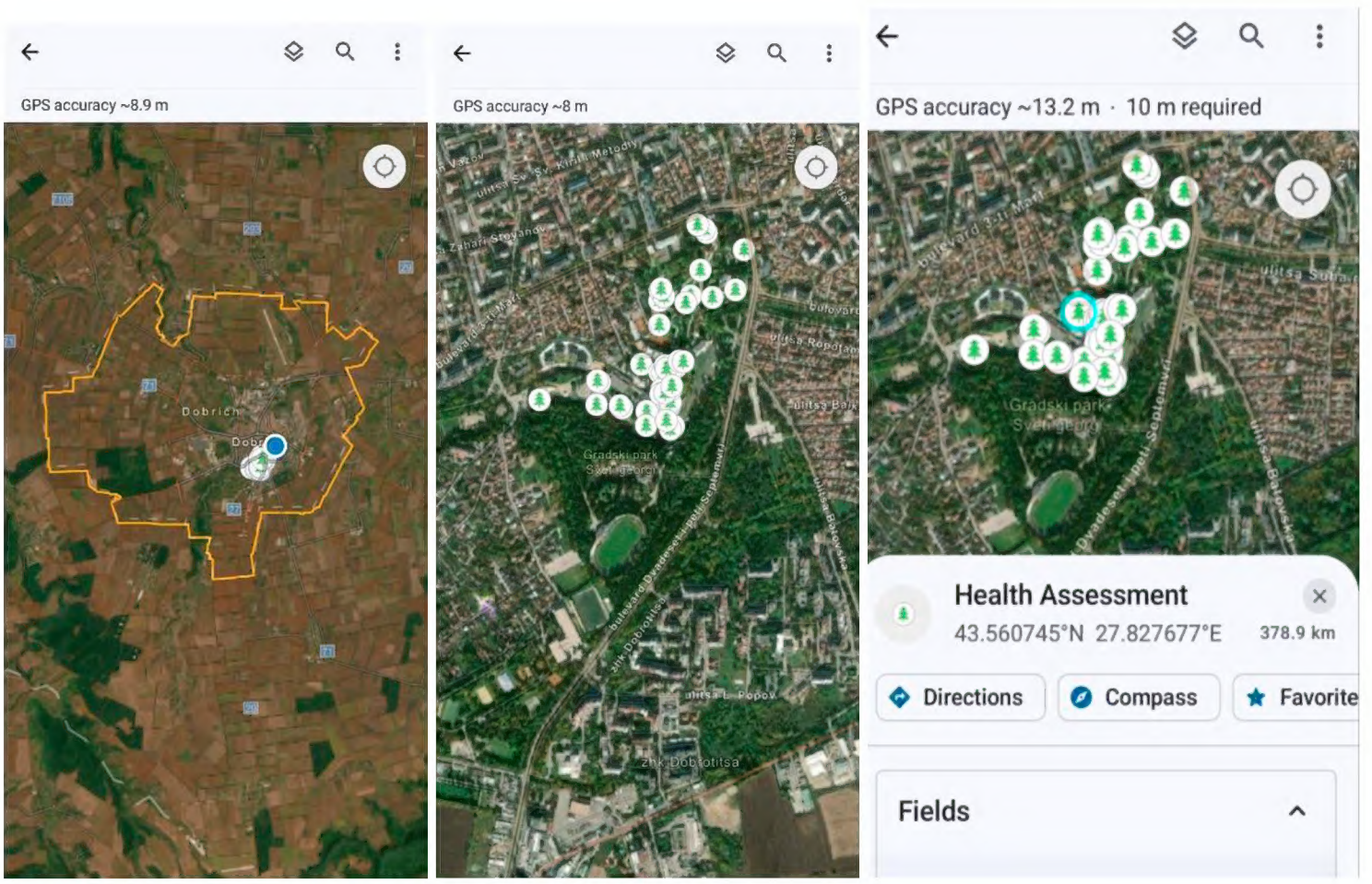

Fig. 2. Application interface of Field Maps Urban Green Area Health Assessment

Additional specific indicators were recorded: the presence of drying or rotted trees that pose a risk to human life and health; the presence of invasive species; the presence of trees colonised by highly aggressive xylophages; and the presence of pests and pathogens capable of causing allergic reactions in animals and people (Georgiev et al., 2017). Biotic agents were classified into three groups based on their harmfulness: less harmful, harmful, and very harmful (Table 2).

Table 2. Studied characteristics of tree health status in 'St. George' City Park, Dobrich.

N	Field name	Data type	Description
1	City	description	Name of the studied city
2	Park	description	Name of the studied park
3	Tree_number	description	Tree number filled in by a person in the field
4	Tree_species	drop-down menu	Tree species selected from a drop-down menu
5	Defoliation_percent	percent	Specific percentage of the absence of leaves on the tree from the entire crown
6	Defoliation_degree	drop-down menu	Slight (<25%); moderate (30-60%); severe (70-90%); dead (100%)
7	Discoloration_percent	percent	What is the specific percentage of leaves that have a change in standard color
8	Affected part	drop-down menu	Leaves; needles, shoots; branches; tree trunk, root, cones
9	Drying_percent	percent	What part of the crown is affected by dry rot, calculated in percentages
10	Drying_descr	description	More free text description about drylands
11	Antr_stem_descr	description	More free text description about anthropogenic damage to the stem
12	Abiotic_dam_descr	description	More free text description about abiotic damage to different parts of the trees (frost cracks/snowfall/ice-breakers/hail/fires/other)
13	Biotic_dam_descr	description	More free text description about biotic damage to stems
14	Category of disease	drop-down menu	Ia. Highly pathogenic fungi, including invasive species
			Ib. Fungi threatening human health
			Ic. Wood-destroying fungi
			IIa. Fungi causing local diseases
			IIb. Fungi impairing the decorative qualities of trees and shrubs
			III. Saprophytic fungi
15	Category of pest	drop-down menu	Ia. Rhizo-, xylo- and stolophages, developing calamities and attacking physiologically healthy trees
			Ib. Invasive destructive species
			Ic. Insects cause severe allergies in humans and animals
			IIa. Xylophages that do not multiply en masse, but are carriers of dangerous diseases in physiologically healthy trees
			IIb. Calamity xylophages, attacking weakened trees, accelerating their death
			IIc. Calamity phyllophages
			III. Small and rare species
17	Harmfulness	drop-down menu	less harmful, harmful, very harmful
18	Notes	description	Add additional records for which there are no fields, but would be important for the completeness of the data
19	Date	selected date	Date and time of collection of the specific point
20	Photos		Attached photos taken at the moment or previously taken

Results

A total of 390 plants were evaluated, representing 36 deciduous and 10 coniferous species (Table 3). Twelve species (*Ailanthus altissima* (Mill.) Swingle, *Albizia julibrissin* Durazz., *Celtis australis* L., *Corylus avellana* L., *Gleditsia triacanthos* L., *Melaleuca alternifolia, Malus* sp., *Morus alba* L., *Parthenocissus quinquefolia* (L.) Planch., *Prunus cerasifera* Ehrh., *Sambucus nigra* L., and *Syringa vulgaris* L.) were evaluated in good condition with no signs of damage. The remaining were rated as slightly, moderately and severely damaged, or dead, with signs mainly caused by biotic factors – pests or pathogens (Table 3). Six insect pests were identified on coniferous and fourteen on deciduous species. Nine of these belong to the very harmful category: (*Cydalima perspectalis*, *Corythucha arcuata* (Say), *C. ciliata* (Say), *Cinara cedri cedri* Mimeur, *Dreyfusia* sp., *Ips typographus* L., *Physokermes* sp., *Tetraneura ulmi* L., and *Scolytus multistriatus* (Marsham).

Fig. 3. Coniferous tree infested by pests: A, B and C – *Abies cephalonica* tree damaged by *Physochermes* sp. in 2024 and 2025; D and E – *Abies concolor* tree damaged by *Dreyfusia* sp.; F – *Cedrus atlantica* infested by *Cinara cedri cedri*.

Table 3. List of pests and pathogens detected on tree and shrub vegetation in 'St. George' City Park, Dobrich.

Plant species	Number of trees	Defoliation, min-max	Pests / Pathogens (category)	Part of a plant- attacked	Harmfulness	Invasive species
Pests on coniferous						
Abies alba	5	20-90%	*Physokermes* sp.	branches	harmful	no
Abies cephalonica	3	50-100%	*Physokermes* sp.	branches	harmful	no
Abies concolor	3	20-50%	*Dreyfusia* sp.	needles, branches	very harmful	yes
Cedrus atlantica	6	10-100%	*Cinara cedri cedri*	needles, branches	very harmful	yes
Picea excelsa	13	10-100%	*Ips typographus*	tree trunk	very harmful	no
Picea pungens	14	10-50%	*Physokermes* sp.	branches	harmful	no
Pinus nigra	10	10-20%	*Cinara pini*	needles	less harmful	no
Pathogens on coniferous						
Larix europaea	2	20-100%	*Lachnellula willkommii*	tree trunk	very harmful	no
Pinus nigra	20	30-40%	*Cyclaneusma niveum*	needles	harmful	no
	15	30-100%	*Diplodia sapinea*	shoots, cones	very harmful	no
	5	30-80%	*Dothistroma septosporum*	needles	very harmful	yes
Sequoia sempervirens	3	30-50%	*Botryosphaeria dothidea*	shoots, tree trunk	very harmful	no
Thuja occidentalis	3	10-20%	*Kabatina thujae*	needles	harmful	no
Pests on deciduous						
Acer negundo	3	20-90%	*Metcalfa pruinosa*	leaves	very harmful	yes
Acer pseudoplatanus	5	70-90%	*Metcalfa pruinosa*	leaves	very harmful	yes
Aesculus hippocastanum	5	30-40%	*Cameraria ohridella*	leaves	harmful	yes
Buxus sempervirens	5	60-100%	*Cidalima perspectalis*	leaves	very harmful	yes
Fraxinus americana	5	30-100%	*Zeuzera pyrina*	tree trunk	harmful	no
Fraxinus angustifolia	5	30-100%	*Zeuzera pyrina*	tree trunk	harmful	no
	3	10-40%	*Prociphilus fraxinifolii*	leaves	less harmful	no
Fraxinus excelsior	5	80-100%	*Zeuzera pyrina*	tree trunk	harmful	no
	3	30-40%	*Prociphilus fraxinifolii*	leaves	less harmful	no
Platanus acerifolia	5	50-60%	*Corythucha ciliata*	leaves	harmful	yes
	5	50-60%	*Phyllonorycter platani*	leaves	harmful	yes
Quercus cerris	15	30-50%	*Corythucha arcuata*	leaves	less harmful	yes
	15	20-50%	*Parthenolecanium rufulum*	brunches	harmful	yes
Quercus robur	5	20-30%	*Phyloxera glabra*	leaves	harmful	yes
Sorbus aria	5	20-50%	*Stephanitis pyri*	leaves	harmful	no

Tilia tomentosa	5	20-60%	*Oxycarenus lavaterae*	tree trunks	less harmful	yes
Tilia platyphyllos	5	30-50%	*Oxycarenus lavaterae*	tree trunks	less harmful	yes
Ulmus minor	6	80-100%	*Scolytus multistriatus*	tree trunks, branches	very harmful	no
	6	20-30%	*Tetraneura ulmi*	leaves	harmful	no
IV. Pathogens on deciduous						
Acer negundo	5	20-90%	*Cryptostroma corticale*	tree trunk, branches	very harmful	yes
Acer pseudoplatanus	5	70-90%	*Cryptostroma corticale*	tree trunk, branches	very harmful	yes
Aesculus hippocastanum	5	30-40%	*Phyllosticta paviae*	leaves	harmful	no
	3	70-80%	*Inonotus hispidus*	tree trunks	very harmful	no
Betula pendula	3	50-70%	*Inonotus hispidus*	tree trunks	very harmful	no
Buxus sempervirens	3	10-20%	*Erysiphe palczewskii*	leaves	less harmful	yes
	2	10-20%	*Volutella buxi*	leaves	less harmful	no
Fraxinus angustifolia	1	100%	*Armillaria mellea*	root, tree trunks	harmful	no
Juglans regia	5	50-60%	*Marssonina juglandis*	leaves	less harmful	no
	4	70-90%	*Inonotus hispidus*	tree trunks	very harmful	no
	1	100%	*Armillaria mellea*	root, tree trunks	harmful	no
Platanus acerifolia	5	30-70%	*Apiognomonia veneta*	leaves	very harmful	yes
	5	30-70%	*Erysiphe platani*	leaves	very harmful	yes
	5	30-40%	*Cytospora platani*	branches	harmful	no
	5	30-70%	*Massaria platani*	branches	harmful	no
	3	70-80%	*Inonotus hispidus*	tree trunks	very harmful	no
Populus × euroamericana	6	20-30%	*Drepanopeziza populorum*	leaves	less harmful	no
	1	70%	*Armillaria mellea*	root, tree trunks	harmful	no
	2	70-100%	*Fomes fomentarius*	tree trunk	very harmful	no
Prunus mahaleb	10	30-70%	*Armillaria mellea*	root, tree trunks	harmful	no
Quercus cerris	15	20-30%	*Microsphaera alphitoides*	leaves	less harmful	no
	10	70-100%	*Biscogniauxia mediterranea*	tree trunks	very harmful	yes
Quercus robur	5	20-40%	*Microstroma album*	leaves	harmful	no
	5	20-40%	*Microsphaera alphitoides*	leaves	less harmful	no
Quercus rubra	3	20-80%	*Biscogniauxia mediterranea*	tree trunks, branches	very harmful	no
Salix babylonica	10	20-40%	*Inonotus hispidus*	tree trunks	very harmful	no
Sophora japonica	10	30-80%	*Inonotus hispidus*	tree trunks	very harmful	no
Tilia platyphyllos	5	30-50%	*Armillaria mellea*	root, tree trunks	harmful	no
	5	60-90%	*Biscogniauxia cinereolilacina*	tree trunk, branches	very harmful	no
Tilia tomentosa	10	60-90%	*Biscogniauxia cinereolilacina*	tree trunk, branches	very harmful	no
Ulmus minor	6	80-100%	*Ophiostoma ulmi*	tree trunk	very harmful	no

Brown hemispherical scales, *Physokermes* sp., were clustered on twigs and resembled buds of *Abies* and *Picea* species. Branches of *Abies alba* Moll. and *Abies cephalonica* Loudon were most severely affected by *Physokermes* sp. (Fig. 3A,B,C), resulting in 20-100% defoliation (Table 2). Growth of the shoots was suppressed, the needles discoloured brown or died if heavily infested. For two years, the attacked *A. cephalonica* trees completely died. The pest was also found in groups on *Picea pungens* Engelm. twigs. The European spruce bark beetle, *Ips typographus*, caused damage and death in 20.0% of *Picea abies* trees.

Severe damage to three young trees of *Abies concolor* (Gordon & Glend.) Lindl. ex Hildebrand was caused by the sucking of larvae of *Dreyfusia* sp. on needles and twigs. The needles and the shoots were deformed, shortened, brown, and dry (Fig. 3D,E).

Among the pest complexes, the share of invasive species was 55.0% (Table 3). Cedar bark aphid (*C. cedri cedri*) was identified on *Cedrus atlantica* (Endl.) Manetti ex Carrière trees (Fig. 3F). Their impact on observed hosts was significant due to their high density, which weakened plants and, combined with improper environmental conditions, caused dieback or even the death of trees.

The study found severe infestations of oak leaves by the oak lace bug (*Corythucha arcuata*) and of plane leaves by *C. ciliata*. They are polyvoltine species growing in number during the vegetation period. The leaf mining moth *Cameraria ohridella* caused significant damage, mainly late summer browning, to the appearance of horsechestnut (*A. hypokastanum*) trees.

Twenty-two pathogen species were identified as the causes of biotic damage both on coniferous and deciduous species (Table 3). Among them, five species fall into the first category of harmfulness—strongly pathogenic and invasive species (*Botryosphaeria dothidea*, *Cryptostroma corticale*, *Diplodia sapinea*, *Dothistroma septosporum*, *Lachnellula willkommii* (Hartig) Dennis, and *Ophiostoma ulmi*), and pathogens that threaten human health and safety (*C. corticale*, *Inonotus* sp.). The remaining were

Fig. 4. Coniferous tree infested by pathogens: A – *Dothistroma septosporum* on *Pinus nigra*; B – *Diplodia sapinea* on *P. nigra*; C – *Botryosphaeria dothidea* on *Sequoiadendron giganteum*.

classified in the second-harmfulness category due to their localised impact on the leaves or needles of host plants. Saprophytic fungi, which are classified as the third category of harmfulness, were not observed on dead plants. Among the pathogen complexes, the share of invasive species was 27.3% (Table 3).

All pine trees (*Pinus nigra*) experienced severe defoliation (30-100%) caused by combined attacks from pathogens. The main causal agents and factors responsible for the observed damage symptoms were the invasive, strongly pathogenic fungi from the first category of harmfulness – *Dothistroma septosporum* (Fig. 4A) and *Diplodia sapinea* (Fig. 4B), which caused significant damage and negatively affected tree vitality. Drought during the two observed growing seasons worsened tree health in the second year, increasing susceptibility to pathogens and resulting in severe damage and mortality.

The health status of *Sequoiadendron giganteum* trees in the central park deteriorated. The invasive fungal pathogen *Botryosphaeria dothidea* was detected on them, causing significant damage and negatively influencing the trees' vitality. *Lachnellula willkommii*, the pathogen of *Larix*, caused necrosis of tree trunks and killed one of the sample trees.

Symptoms of oak infection by *Biscogniauxia mediterranea*, including branch and stem necrosis, were identified on *Quercus cerris* and *Q. rubra* trees. The bark above the affected areas appeared black and sooty, with cracks that often exuded amber-colored sap. Dark necrotic lesions were visible after bark removal. Branch cankers were common on infected oaks. *Biscogniauxia cinereolilacina* (J.H.Mill.) Pouzar. caused severe infection and crown defoliation (60-90%) on *Tilia platyphyllos* (L.) Moench and *T. tomentosa* Moench trees.

The introduced invasive pathogen *Cryptostroma corticale* was detected, causing significant damage and adverse effects on the vitality of *Acer pseudoplatanus* (Fig. 5A) and *A. negundo* trees. Wet brown-colored necrosis caused by *Phytophthora* sp. was found on tree trunks of *Platanus acerifolia* (Fig. 5B).

Fig. 5. Deciduous tree infested by pathogens: A – *Cryptostroma corticale* on *Acer pseudoplatanus*; B – *Phytophthora* sp. on *Platanus acerifolia*; C – *Armillaria mellea* on *Fraxinus excelsior*.

The development of destructive timber fungi on tree stems and branches, which poses a threat to human life and health (first category of harmfulness), was observed. Infections with *Inonotus hispidus* developed on branches or stems of *Juglans regia*, *Platanus acerifolia*, *Aesculus hippocastanum*, *Sophora japonica*, *Salix babylonica*, and *Betula pendula*, causing white, central rot. Root rot disease caused by the destructive pathogen *Armillaria mellea* (Vahl: Fr.). Kumm. damaged severely and caused death to *Fraxinus angustifolia*, *Juglans regia*, *Populus* × *euroamericana* (Dode) Guinier, *Prunus mahaleb* and *Tilia platyphyllos* (Fig. 5C). On the poplar trees, necrosis caused by *Cytospora intermedia* Sacc. was noticed. On the same trees between 10 and 25 plants of the semi-parasites species *Viscum album* L., were noticed.

On the leaves of horse chestnut (*A. hippocastanum*), the invasive species *Phyllosticta paviae* developed along with the leaf-mining moth (*C. ohridela*). Fungal pathogens belong to the second harmfulness category, causing local, non-aesthetic damage to green vegetation used for planting, and were identified in all selected case-study areas.

A standard management practice in the 'St. George's City Park tree crowns were pruned, typically conducted for aesthetic purposes and to avoid contact with nearby infrastructure. Mechanical damage from visitors or park workers was observed on individual trees at all selected sites. Tree wounds started the decay process and eventually caused the trees to die. The spread of destructive timber fungi on tree stems and branches endangers human safety and health.

Discussion

The observations were conducted to evaluate the health status of tree and shrub vegetation in various sub-types of 'St. George' City Park in Dobrich. Field observations included assessing crown defoliation and changes in foliar discolouration as indicators of tree health status. These indicators suggest the presence of damaging biotic or abiotic agents, as evidenced by changes in crown condition (Ferretti, 1997). Among the common tree genera, *Pinus* and *Ulmus* were most severely affected. The insects, diseases, and other damaging agents impacting the green ecosystems of Dobrich, which hinder their ability to provide goods and services, were categorised into three groups based on their level of harm.

Diseases affecting urban trees and shrubs are caused by adverse ecological conditions. Deterioration of habitat conditions often enables harmless pathogens to become highly damaging, harming plant tissues and organs. This results in physiological weakness in trees, reduced biological resistance to insect attacks, and the emergence of secondary diseases. In Bulgaria, prolonged droughts during recent growing seasons have weakened the physiological functions of forests and park vegetation, increasing their vulnerability to new diseases caused by invasive pathogens. Diseases and wood decay cause the greatest losses and have the most severe negative effects on tree growth, surpassing all other causes in their destructive impact.

Botryosphaeriaceae are opportunistic pathogens that often reside in host tissues without causing symptoms, becoming pathogenic only when conditions favour disease development. These predisposing stresses can include environmental factors such as transplanting, pruning, herbicide use, insect damage, and water stress. Latent infections are important because they can serve as reservoirs for pathogens, allowing them to survive and multiply under favourable conditions. This can lead to disease outbreaks that damage tree growth or even cause tree death. Additionally, latent infections can disrupt disease control efforts. The diversity and ubiquity of the Xylariaceae family may also be linked to their association with insect vectors that are trophically connected to plants (Guidot et al., 2003; Pažoutová et al., 2010).

Biscogniauxia mediterranea, the causal agent of charcoal canker in *Q. cerris and Q. rubra* is increasingly associated with forest decline, especially under water stress in recent years, endophytic colonisation by the pathogen in host tissues has been reported under severe drought and physiological stress. In 2023-2024, damage by *B. mediterranea* caused severe disease development and rapid mortality of red oak trees (*Q. rubra*), used for afforestation in field protective forest belts in northeastern Bulgaria (Georgieva et al., 2024). The pathogen is new to *Q. rubra* in Europe and, for two years, caused the death of red oak trees at many sites across the country.

Detection of the endophytic stage of latent fungal pathogens can serve as an indicator of drought stress in the host species (Desprez-Loustau et al., 2006). The detection of the asymptomatic phase of latent pathogen development in the host is of paramount importance for the study of disease development, especially the transition from latent to active colonisation in plant tissues.

The central area of Dobrich is the largest green space in the city centre. The vegetation covers less than 50% of the area. Recently introduced invasive insects, such as *Cameraria ohridella*, *Corythucha ciliata*, and *Cydalima perspectalis*, could pose the biggest threat to the trees and shrubs. Although their population was low during the study period (end of May to early July), they are polyvoltine species, meaning their numbers grow during the growing season. *C. ohridella* was first established in Bulgaria in the late 1980s (Pelov et al., 1993), but it is now widespread across the country, causing significant damage to *Aesculus hippocastanum*. The Nearctic *C. ciliata* was first recorded in Bulgaria in 1989 (Josifov, 1990) and is now distributed throughout the country on *Platanus* species. Another species from the genus *Corythucha*, *C. arcuata*, was reported in Bulgaria as a pest of oaks (*Quercus* spp.) (Dobreva et al., 2013)

The North American lace bug *Corythucha arcuata* (Say, 1832) is now commonly found on oak trees in urban green spaces. It has been observed on *Quercus robur* and *Q. cerris* in the regions of Plovdiv and Simeonovgrad (Dobreva et al. 2013).

The Asian *Cydalima perspectalis* was detected in Bulgaria in 2013 (Beshkov et al., 2015). It is now widespread as a destructive pest of *Buxus sempervirens* in many regions, including Dobrich. The Nearctic *G. cooleyi* is the most dangerous insect pest of Douglas fir (*Pseudotsuga menziesii*) in Europe. It was established in Bulgaria in 1989 (Tsankov et al., 1990) and is now widely distributed across the country. This species produces several generations per year and forms colonies of varying density after mid-May.

The decline of all *Pinus nigra* trees was caused by two invasive pathogens, *Diplodia sapinea* and *Dothistroma septosporum*. In recent years, these pathogens have become highly virulent, causing severe damage to both native and introduced pine species nationwide. This has adversely affected their growth and appearance, ultimately leading to the trees' complete death (Georgiev et al., 2017).

The newly introduced invasive pathogens – *Botryosphaeria dothidea* (Georgieva, 2017) and *Cryptostroma corticale* (Bencheva, 2014) – were found to cause significant damage and to negatively affect the vitality of host trees in 'St. George' city park. The aggressiveness of these pathogens is evident in the irreversible damage they cause to the stems and branches of infected trees. Additionally, *C. corticale* can also pose health risks to humans. Inhaling large amounts of spores produced by fruit bodies may cause respiratory difficulties and lung inflammation (Douzon, 2007). The pathogen B. *dothidea* is widely present in city parks across the country, where ornamental exotic species such as *Sequoia sempervirens*, *Sequoiadendron giganteum*, and *Juniperus virginiana* are planted (Georgieva, 2016).

Elm (*Ulmus minor*) trees are planted in urban green spaces in Dobrich. The development of severe, invasive infections caused by the pathogen *Ophiostoma ulmi* in the vascular system of infected trees has led to their decline and death. The rapid progression of this disease was influenced by successful interactions between the pathogen and the reproductive characteristics of the insect vector, the elm bark beetle (*Scolytus multistriatus*). Because many of the affected trees grow along streets and in central parks, the pathogen's activity poses a risk to public safety, and dead wood must be removed before it becomes an unacceptable hazard.

Invasive alien pathogens can cause substantial economic damage and harm biodiversity and human health (Fisher et al., 2012; Fones et al., 2020). When they infect native hosts with which they have no co-evolutionary history, high host mortality rates can occur (Fisher et al., 2009, 2012; Hansen et al., 2012). Additionally, invasive alien fungal pathogens threaten economies and human well-being (Bebber et al., 2014; Ogden et al., 2019; Fones et al., 2020). In many areas, the number of new invasive alien fungal pathogens established in forestry systems has increased significantly (Santini et al., 2013; Burgess, Wingfield, 2017), and there is a long history of pathogens spreading with crops worldwide, sometimes causing devastating epidemics (Santini et al., 2018).

Conclusions

Urban environments host invasive alien species that threaten planted vegetation in green spaces. The invasion of non-native pests and pathogens has significantly worsened the health and aesthetic appeal of the tree species studied in 'St. George' City Park in Dobrich. As temperatures rise, the adaptive capacities of tree species are increasingly outpaced by environmental changes, making them more vulnerable to pests, pathogens, and climate stressors. Non-native and invasive species pose a significant threat to global biodiversity and related ecosystem services. In cities, these invasive

species impose economic costs and reduce residents' quality of life due to high population densities and extensive infrastructure. Implementing biosecurity measures is crucial to reducing the risk of invasive pests and diseases in urban ecosystems.

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